Synthesis, Characterization, Analytical and Biological Applications of Novel Schiff Bases

A

SYNOPSIS SUBMITTED

TO

UNIVERSITY OF MUMBAI

FOR THE DEGREE

OF

DOCTOR OF PHILOSOPHY

IN

CHEMISTRY.

UNDER THE FACULTY OF SCIENCE

BY

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(PRESCRIBED FORMAT FOR SUBMISSION OF PRE-PROPOSAL FOR TOPIC APPROVAL IN THE FACULTY OF SCIENCE AND TECHNOLOGY)

PROPOSAL FOR TOPIC APPROVAL TO BE SUBMITTED TO THE UNIVERSITY OF MUMBAI FOR THE PH.D. DEGREE IN THE SUBJECT OF **CHEMISTRY**.

Title of Topic	:	Synthesis, Characterization, Analytical and Biological Applications of Novel Schiff Bases.
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1. **Title:** Synthesis, Characterization, Analytical and Biological Applications of Novel Schiff Bases.
2. **Aim:** To Synthesis and characterize transition and inner transition metal complexes of Novel Schiff Bases. Also to study Analytical and Biological Applications of all novel compounds prepared.

3. **Objectives:**
   1. To prepare the novel salen type Schiff base chelating agent/s and to characterize by using spectroscopic methods.
   2. To synthesize complexes of newly prepared salen type chelating agents prepared as in (1) with transition or inner transition metals and to characterize them by using different techniques
   3. To study Analytical applications of the newly prepared salen type chelating agent with the help solvent extraction methods.
   4. To study the biological applications of all newly prepared compounds.

4. **Introduction:-**

Schiff bases sustain Azomethane(–C=N) unit. This is the primary condensation of amines with carbonyl compounds and have been reported by Hugo Schiff [1-3]. Schiff bases have a wide variety of applications in different areas such as biological chemistry, organic and inorganic chemistry.

The medicinal uses and applications Schiff bases and their metal complexes are of increasing clinical and commercial importance. Schiff bases have picked up significance in medicinal and pharmaceutical field because of an expansive range of biological activities like anti-inflammatory [4-7], analgesic [5-8], antimicrobial [9,10], antispasmodic [11], tuberculosis [12], anti-cancer [13,14], antioxidants [15], anthelmintic [16]. Schiff bases are also administered as catalysts, intermediates in organic synthesis, pigments, dyes, polymeric stabilizers [3] and corrosion inhibitors [17].

Depending on the number of ligands, attached to the metal ion, the mixed ligands complexes can be bi-ligand, tri-ligand, tetra-ligand or multi ligands complexes. The formation of mixed ligands complex and their properties can be crucial from the point of view of the kinetics effect[18] .

The coordination chemistry of transition metal complexes with mixed ligands are of current interest because they can provide new material with useful properties such as magnetic exchange [19], electrical conductivity [20], photoluminescence [21], non linear optical commonly properties [22], antimicrobial activity[23].

Solvent extraction of metal ions has been used for a long time for separation and determination of metal ions. The first quantitative description of the extraction process was, however, not made until 1941 when Kolthoff and Sandell [49] compared experimental data with theoretical predictions for the extraction of metal dithizonates.

They found that the theory they proposed was valid under wide experimental conditions. However, the systems used by Kolthoff and Sandell were simple ones and hence relatively simple theory was used to successfully explain their behavior. In practice solvent extraction systems are complicated by other factors, e.g. hydrolysis, polymerization and complex formation in aqueous phase.

It has subsequently become apparent that such factors have an important influence on the solvent extraction of chelates. Several authors [50-54] have published reports since 1941 on the theory of solvent extraction of metal chelates which take these factors into account. In particular two publications by Irving, Rossotti and Williams and Stary should be noted for their comprehensive treatment of the subject.

The role of mixed ligands complex in biological process have been well recognized [24]. The biological importance of mixed ligands complex is that they are sometimes more effective than the free ligands [25,26]. On other hand, the increase in the importance of coordination compounds is also related to the fast of that biological system of coordination compounds [28].

The field of solvent extraction, commonly called liquid–liquid extraction, has grown extensively in the past half century to become an economically significant family of techniques in industry, analytical chemistry and research.[30,31,32,33] Moreover, liquid–liquid extraction has important applications in the removal of toxic metal ions from the environment and pollution prevention.[33,34]

field of solvent extraction, called liquid–liquid extraction, has grown extensively in the past half century to become an economically significant family of techniques in industry, analytical chemistry and research. Moreover, liquid–liquid extraction has important applications in the removal of toxic metal ions from the environment and pollution prevention.[35,36]

Crown ethers were also used as spectrophotometric analytical reagents. For example, the use of some crown ethers for the measurement of lithium in biological samples has been reported. Metal ions have enormous importance in many biological processes[38,39] Especially, heavy metal ions are effective enzyme inhibitors exerting toxic effects on living systems.

Therefore, separation and determination of toxic metal ions such as mercury, lead and cadmium in environmental sources play an important role for healthy life. Although the using of crown ethers in determination and separation of alkali metals has been thoroughly investigated, their usage as extractant for the mentioned toxic metals has relatively received little attention[40,41].

Kantekin others have reported the use of $N_2O_2S_2$ Schiff base containing aromatic moieties for the transfer of various metal ions from the aqueous phase into the organic phase in liquid–liquid extraction system. In this work, we have been interested in the design and synthesis of $N_2O_2S_2$–crown ether extractants for the selected metal ions, which have bigger cavity size. The aim of this investigation is design and synthesis of two novel ligands, and also solvent extraction properties for the metal cations such as Cu^{2+}, Cr^{3+}, Hg^{2+}, and UO_2^{2+} have been investigated[30]

5. Study Background (Literature Review) International status:

- Schiff base are important class at ligand in coordination chemistry. Schiff base was first reported by Hugo Schiff 1864. Schiff base can be syntheised by condensing of carbonyl compounds and amines in different conditions.
- Amel Djedouani and his team mate reported the work synthesized copper complexs.
- Casabo J reported synthesized complex of 4-hydroxy-6-methly-3[3-dimethylacryoly]-2H-pyran -2-one in 1990.
- Hafeez Ullha and his co-workar reported as synthesis of Schiff bases derived from dehydroacetic acid with various substituted aniline in 2015.
- Jain S and his team mate reported synthesized Schiff base metal complx as antimicrobial and anticancer agent in 2022 [29].

6. National Status

- A.K.Gupta, R.Pal Departments of chemistry Maharshi Markandeshwar university mullana (Ambala) reported dehydroacetic acid based Schiff bases and their metal complexes in 2014.
- Sathe B.S and his teammate reported as to synthesized, characterization and anti- inflammatory evaluation of new florobenzothiazol Schiff base in 2011.
- Prakash A, Adhikari D reported as application of Schiff base and their metal complex in 2011.
- A.A Jadhav and his teammate reported as solventless synthesis of salenadiazol derivatives and their antimicrobial studies in 2016.
- Raju S. K and his co- worker reported as biological application of Schiff base in 2022.

7. Study Hypothesis:-

Transition and inner transitionbased metal complexes /doped complexes have effective magnetic, catalytic, biological and optical property. Therefore, they are use in various field to make photonics devices such as sensor photodiode, security gazzets etc. In medicinal field use as a anticancer, analgesic, antimicrobial, antiplasmodic properties. Also use in the intermediate in various types of organic Synthetis, dyes, paint, polymer etc.

Detailed study of newly synthesized transition metalbased complex for electronic and biomedical purpose.Using various analytical method such as job's method, mole ratio method, slope ratio method etc.to determine the concentration of metal-ligands complex. Also use of Salen base complex in different catalytic reaction and biomedical science.

Detailed study of newly synthesized metal complexs using various modern analytical spectral techniques such as spectrophotometry, atomic absorption spectroscopy,atomic emissions spectroscopy etc. to analyze their different applications in various fields.

Also analyze different surface analysis techniques such has SEM, TEM, ESCA etc to analyze their oxidizing capacity of metal complexs.

8. Study Rational:

Transition and inner transition Schiff base metal complexes have effective biological properties such as anticancer ,antiviral, antimalerial ,antifungal etc .And also medicinal field such as drugs carrier,medicinal diagnosis ,biosensor/ bio probe etc.

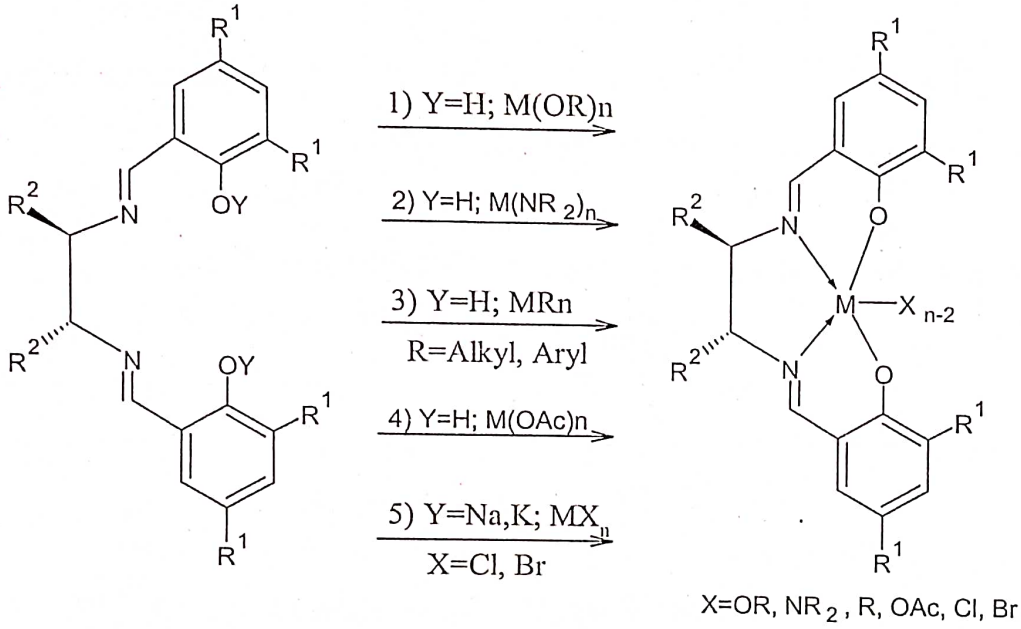
9. Research Methodology:-

- **Synthesis of Novel ligands:** Ligands will be prepared as per literature reports and then will further be used for preparation of metal complexes.
- **Characterization of Novel ligands:** The ligands which are used for Synthesis of metal complexes will be characterized by different physical method such as Electronic Spectra, IR, ^{1}HNMR & ^{13}CNMR, Elemental analysis etc.
- **Synthesis of metal complexes:** Metal complexes will be prepared by using different transition and inner transition elements.
- **Characterization of metal complex:** The prepared metal complexes will be characterized using physio-chemical methods and analytical methods such as Electronic Spectra, IR, ^{1}HNMR & ^{13}CNMR, Elemental analysis, TGA & DSC, MS, ESR, X-Ray studies etc.

- **Studies of metal ligands complex:** A new spectrophotometric method for extraction of various metal ions will be studied. The optimum extraction conditions will be investigated by studying the experimental parameters such as effect of solvent, pH, reagent concentration, equilibration time, sensitivity and interference with foreign ions. The composition of complex will be studied by mole ratio method, Job's continuous variation method and slop ratio method.
- **Biological Studies:** The ligands and metal complexes will be tested for biological activities such as antimicrobial, antiviral, anticancer properties etc.

10. Experimental Design:

Proposed synthesis Scheme:



11. Statistical Plan :

Months	Plan Of Research Work
1 to 6	Course work and Literature review
7 to 24	Laboratory work
25 to 30	Result analysis and outcome
31 to 36	Synopsis and thesis writing

12. Research Design:

Phase: I

Review of literature

Preparation of ligands

Preparation of metal complex

Phase:II

Characterization of complex

Phase: III

Analysis and compilation of data,submission of thesis.

13. Limitations:

Factors that affect solvent extraction

pH affects stability and charge on the metal complex. We need to maintain pH at which metal ion complex is most stable.

Solvent extraction method is convenient only at microscale analysis so it is require to use another method or assembly for macroscale analysis.

14. Expected Outcome:

- Metal Complexes shows various biological activity against gram+ and gram – microorganisms. Therefore, they could be used in medical field.
- Metal ligands complexes shows various activities therefore, they could be used as catalysts.
- Salen type ligands have proved to be useful in extracting various metal ions from aqueous phase into organic phase. Hence the spectrophotometric methods could be useful in removing various pollutant metal ions from water bodies

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